Detection of Unrevealed Information on the Video Using DCT, DWT Watermarking Techniques against Barrel Distortion

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Abstract— Digital data are easily disturbed by unauthorized persons. Securing the digital data is the necessity of multimedia systems. To make the security of digital data lots of techniques comes into being. Watermarking technique is one of these. The current, most beneficial technique for the purpose of security is watermarking technique. To conceal the watermark in the video is called video watermarking. In video watermarking, the user has a copyright of own product. Thus, users prevent the information from external interference. There are multiple methods for hiding the watermark data into the multimedia objects e.g. DCT, DWT etc. When the multimedia objects are passed into the system, then multiple distortions occur at the transmission end. This distortion affects the watermark data. The attacks and distortion are the biggest problem for the watermarked video. To safe the watermark from such type's disasters is not a small work, but it is necessary to protect watermark from this disaster. If we do not stop this type of disasters the authorized users can face the problems and also authorized users can lose all of your rights on. In this paper, we are working on the DCT and DWT methods for hiding the watermark data and also detected the watermark data from the distorted watermarked video. We also compare the both method's correlation and SSIM values at different PSNR and find out better results from both techniques. We are also showing the effect of PSNR on watermarked video.

Index Terms— Video watermarking, DCT, DWT, PSNR, Correlation, SSIM

1INTRODUCTION

AT present time the use of digital data rapidly. Today digital data are need of every person. Given the increasing demand for digital data, our responsibility towards this has also increased [1]. The main responsibility towards digital data is copyright protection, security, tampering protection etc. Watermarking method is used in many places like postage stamps, currency and it is also used in government documents [2].
Nowadays watermarking is used in digital data like images, video etc. For embedding the watermarks in the video two main methods are used. One is DCT and second is DWT.

At recent times the watermarking process draws on many people's work. Especially for people who have the ability to create something of their own. It's very helpful for those people. It provides the security, copyright protection for these types of people [3]. That is why watermarking become a most popular research topic for researchers. There is a lot of work had been done on the watermark by the researchers, but lots of issues come in existing watermark technique. In watermark embedding process firstly we do frame extraction. After frame extraction we are embedding the watermark data and further extracted frame will combine and make a watermarked video. The frame selection is also depending upon some factors. After selecting the suitable frame, we are embedding the watermark data on that selected frame and make a watermarked video. In the watermarking technique, we do the work so carefully because nobody should be known about the watermark data [3 4].
Capacity, security, robustness, imperceptibility is necessary in the video watermarking [3-5]. During watermarking time the quality of the video remains constantly good. The previous techniques had major drawbacks, so there is a need to develop a new watermarking techniques e.g. DCT, DWT, LSB, spread-spectrum [6-11]. In this paper, we are using both spatial as well as transform domain for an accurate watermarking and also work on robust and invisible watermarking. We are also adding the barrel distortion into the watermarked frame and detect the watermark data from the distorted watermarked video's frame. The distortion is applied on both techniques and finds the watermark data and comparing the both techniques results. We are finding the best technique for the barrel distorted watermarked video.

The watermark technique is so simple and important for every authorized user. In embedding process, we have chosen the one image which is embedded into the original video. The one secret key is used for embedding as well as extraction process. The same key K is used at both processes. We also show the process of the watermarking with the help of block diagrams.

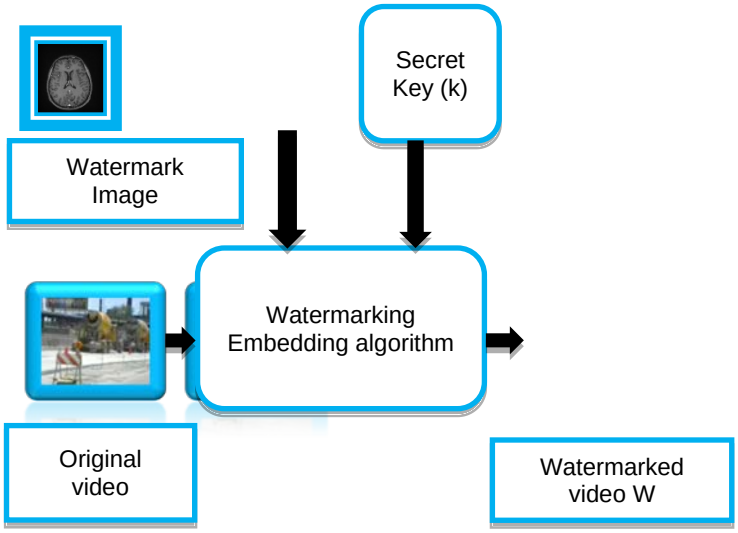

Fig. 1 Process of embedding the watermark [5]

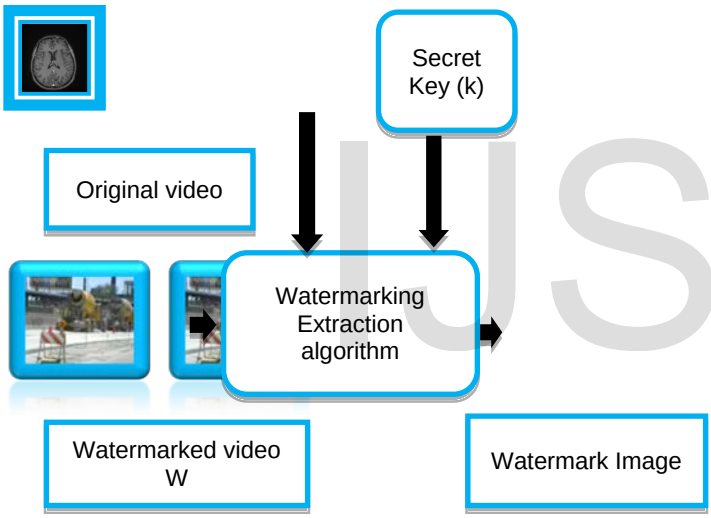

Fig. 2 Process of extraction the watermark [5]

1.1 Applications of digital watermarking

Digital watermark has various applications in many fields. The main applications of digital video watermark are [5]:

1. If provides copyright protection from the unauthorized users.
2. It is used in the broadcasting system.
3. It is also used in a source tracking system.
4. It provides video authentications/confirmation.

1.2 TECHNIQUES FOR VIDEO WATERMARKING

The numbers of techniques are developed for implementing watermark in a video. The two most popular techniques arediscussed.

1. DCT (Discrete Cosine Transform)
2. DWT (Discrete Wavelet Transform)

In this paper, we are explaining both techniques one by one.

1. DCT (Discrete Cosine Transform): It is best suitable for the approximation of the signal. Many algorithms are used in DCT technique for watermarking purpose. It is faster than the DWT technique. For the purpose of decomposition of the frame in the DCT technique watermark is embedded into the center frequency [5].
2. DWT (Discrete Wavelet Transform): In DWT each frame is divided in two four small equal parts. These four parts are named as horizontal part, vertical part, diagonal part and approximation part. The frame of an object is also divided into subparts for getting low resolution frame. In this process, we are using the 2-level wavelet decomposition. For watermarking DWT is more efficient technique. This technique is also providing the multi-resolution.
   The main advantages of DWT technique are to handle distortion/interference in the video's frame [6 7].

2 PROBLEM FORMULATIONS

As the time passed, the demands of the people increased. By increasing the demand of the people new devices have been developed. There are also some drawbacks in the use of new devices like HMD devices is so attractive nowadays, but in which wide angle lenses are used which cause the pincushion distortion in the video. To cancel out this distortion we are also adding the barrel distortion at the back end of the video. This addition of the video may be damaging the watermark data. Multiple researchers have been working on it and detect the watermark data. But all researchers commonly used one parameter (correlation) to finding the watermark frame. With the help of one parameter (correlation), we cannot acquire the good and accurate results. To remove such types of problem we are using the two techniques for watermarking and also using two parameters for finding the watermark data.

3PROPOSED WORK

The drawbacks were defined on the problem formulation. So to remove this problem we have made new algorithms. In my proposed work, we are detecting the watermark data with the help of two parameters and also using the two techniques for embedding the data into the watermarked video. We are showing the effect of PSNR on the watermarked video and also finding the correct watermark in the 1 correct and 199 incorrect key.

3.1 TECHNIQUE USED

In my proposed work, we are using the technique to finding the watermark data from the watermarked video is shown below:

3.1.1 DCT (Discrete Cosine Transform)

In this method, firstly we are using the spread spectrum technique for finding out the location of pixel value where we can be embedded the watermarked data [8-10]. After SS (spread spectrum) we are applying the DCT technique.
We also explain my proposed work on the steps:

1. First, we are generating the pseudo random sequence w_1. The range of the watermark sequence {-1, 1}. The mean of the w_1 is zero.
2. The next step is to convert the 1D sequence w_1 to 2D sequence w_2 in the pre-selected zigzag scan.
3. The intermediate frequency DCT coefficient is not modified, but all coefficients are changed to zero.
4. Now applying the IDCT on the w_2 and produce the final watermark mask W.
5. Final step is to embed the W into the original frame I and produce I^*.

$$I^* = I + (a - x)W \quad (1)$$

a is the strength of the watermark. It checks the distortion level.

3.1.2 DWT (Discrete Wavelet Transform)

In DWT technique, we firstly apply DWT for providing the compression and multi-resolution of the original video's frame. Now, we apply the spread spectrum technique for finding the location of the original video frame's pixel value where we embed the watermark data. After finding the location we are applying the LSB (Least Significant Bit) technique for exchange the last/ least bit of the original video's frame with the watermark image pixel value [8-11]. With the help of DWT technique is used for embedding the watermark data and last step is to apply the IDWT to reconstructing the original video's frame.

In this paper we are also working on barrel distortion model [12-16].

4 METHODOLOGY

In this paper, we are totally working on the distorted watermarked video and embedding the watermark data by using the DCT and DWT technique. The steps which are used in my proposed work shown below:

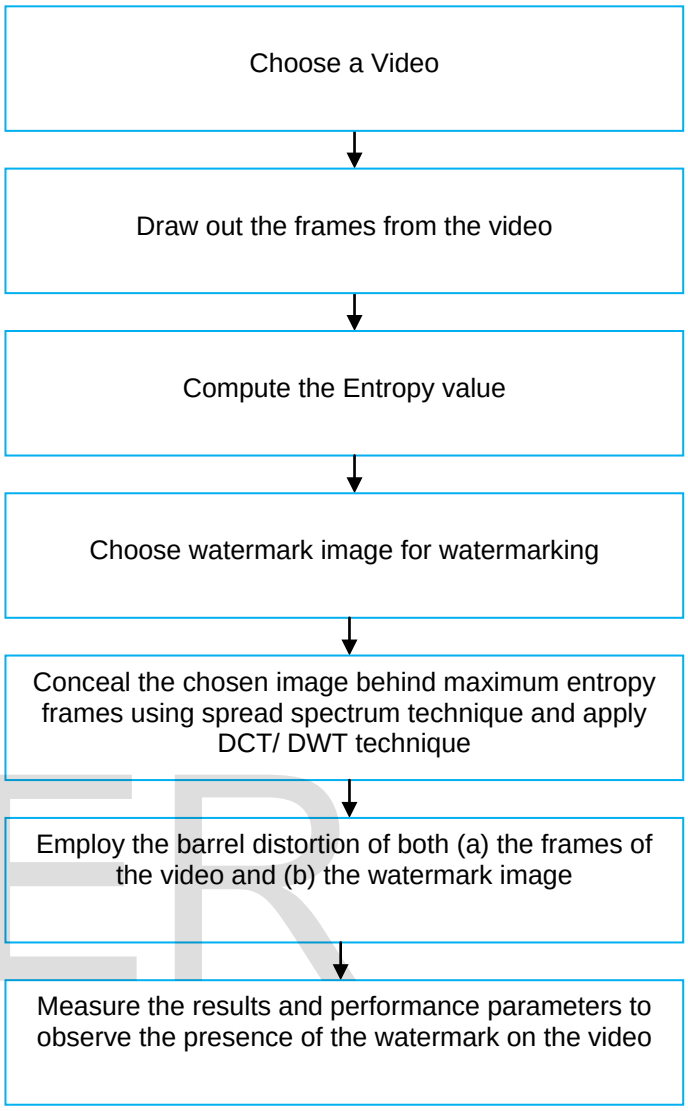

Fig. 3 Block Diagram, of proposed work

1. The first step is to choose the original video. In this choosing video we embed the watermark data.
2. The second step is drawing out the frames from the choosing video.
3. The third step is to compute the entropy value. The entropy is calculated by the equation:

$$Entropy = -\sum P_i log_2 P_i \quad (2)$$

P_i is the probability of the variation among two adjacent pixels.

4. The fourth step is choosing the watermark image for video watermarking.
5. The fifth step is to select high entropy frames and spread spectrum on this frame for finding the location and apply the DCT on the first method and second time apply DWT method.

6. The sixth step is to apply the distortion on the watermarked frame and watermark image.
7. The seventh and last step is used to find out the correlation, SSIM at different PSNR value and detect the watermark data.

5 RESULTS AND EXPERIMENTS

In my proposed work, we are using the two techniques for embedding the watermark data and also doing the comparison in between the two techniques. We are also representing the graphical form of the correlation, SSIM at different PSNR values.
The three parameters which are used for evaluating the results which are shown below:

5.1 PSNR (Peak to Noise Ratio)

It is a first parameter for evaluating the results. Sometimes SNR is known as PSNR. It is the ratio of power with respect to noise. This noise is affecting the signal. PSNR gives the quality of the signal. The signal may be any form image/audio/video. If the value of the PSNR is high, it means the quality of the signal is better.

$$PSNR = 20.log_{10}(MAX_1) - 10.log_{10}(MSE) \quad (3)$$

By this equation, we are calculating the PSNR value. MSE stands for the mean square error. It is essentially employed for evaluating the mean of the square of the error and MAX is the maximum possible value of the video's frame.

5.2 Correlation

The second parameter which is used is called correlation. The correlation gives the information about two signals. How much these signals are correlated. The correlation values lie in between 0 to 1. If the value of the correlation is low range (0 to 4) it means two signals are not correlated. If its range is lying in between (5 to 1) it means it is highly correlated.

5.3 SSIM (Structural similarity index measure)

This is a third and last parameter which is used in my proposed work. SSIM gives the information about the similarity between the two signals. The SSIM values also lie in between 0 to 1. If the value of the SSIM is low range (0 to 4) it means two signals are not similar. If its range is lying in between (5 to 1) it means it is highly similar. The equation is used to find SSIM is shown below:

$$SSIM(x,y) = \frac{\left(2_{\mu_x\mu_y} + c_1\right)\left(2\sigma_{xy} + c_2\right)}{\left(\mu_x^2 + \mu_y^2 + c_1\right)\left(\sigma_x^2 + \sigma_y^2 + c_2\right)} \quad (4)$$

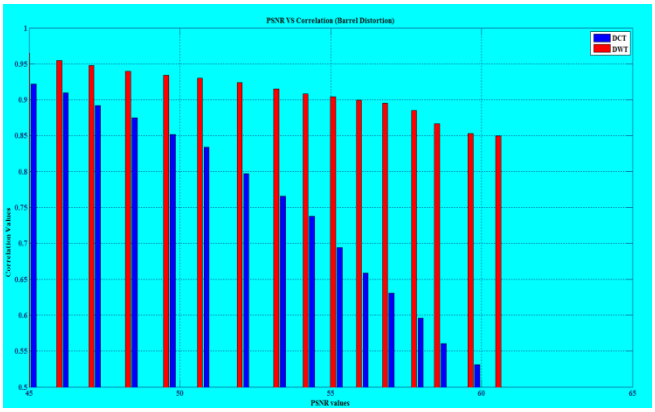

Fig. 4 The relation between PSNR with Correlation

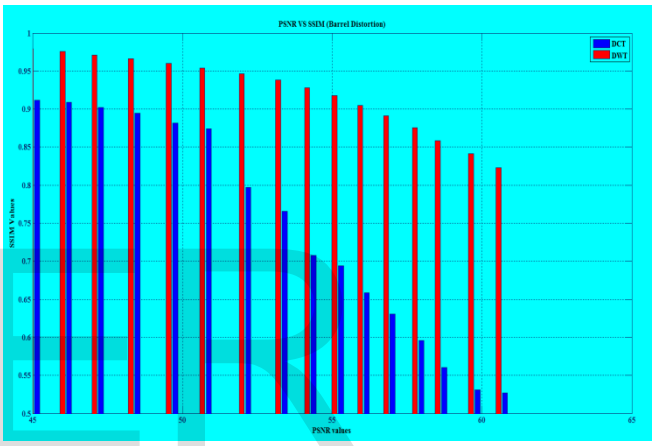

Fig. 5 The relation between PSNR with SSIM

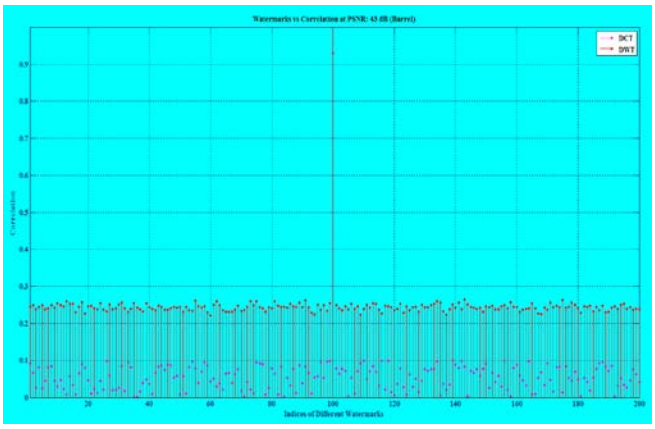

Fig. 6 Correlation responses of the watermark detector to 1 correct watermark and 199 random watermarks at 43 dB

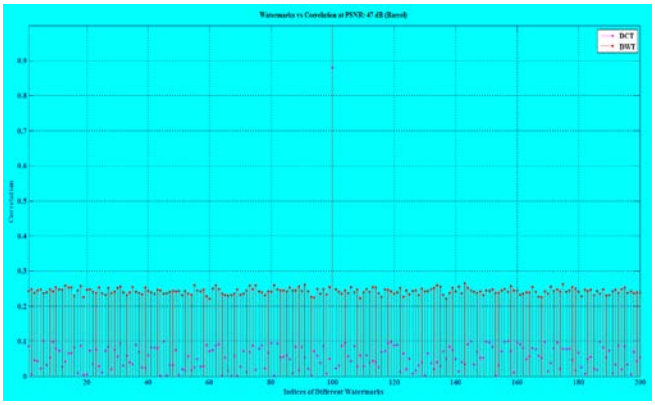

Fig. 7 Correlation responses of the watermark detector to 1 correct watermark and 199 random watermarks at 47 dB

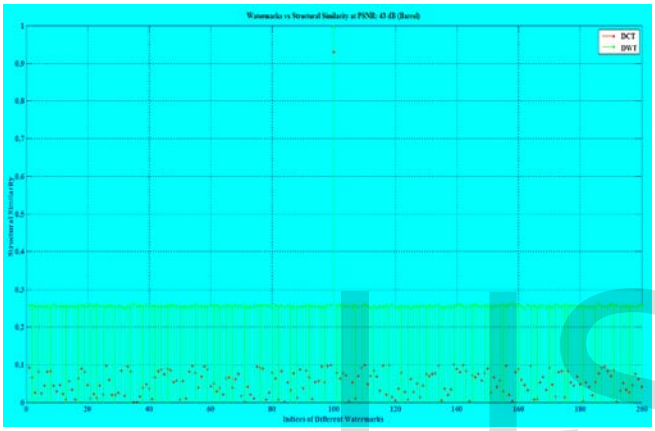

Fig. 8 Structural Similarity Index responses of the watermark detector to 1 correct watermark and 199 random watermarks at 43 dB

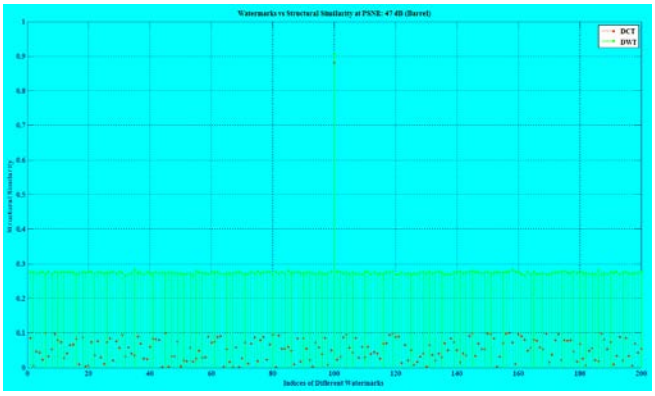

Fig. 9Structural Similarity Index responses of the watermark detector to 1 correct watermark and 199 random watermarks at 47 dB

(a) (b) (c)

Fig. 10 Watermark imperceptibility (a) Original images. (b) Watermarked images with PSNR=43 dB. (c) Watermarked images with PSNR=47dB

Watermark imperceptibility is an important factor of video watermarking. Watermark imperceptibility is so necessary for the video watermarking. In this type of watermarking people cannot see the watermark data from the watermarked video. We are also showing the watermark imperceptibility at different-different PSNR.

For getting out the watermark information, we have made 200 watermarks. In the 200 watermarks we have chosen 1 correct watermark and 199 incorrect watermarks. The correlation and similarity index value is high at the point of correct watermark. The correct watermark is present at 100 point and we are detecting the watermark data from the distorted watermarked video with the help of correlation and SSIM parameters. In this method, we are also working on the barrel distortion and we are also using the DCT and DWT technique for watermarking process.

6 Conclusion

In this paper, we are getting the watermark data from the distorted watermarked video. The distortion which is present in the watermarked video is barrel distortion. We are using the two techniques for the watermarking process. We are concluding that DWT has more effective results as compared to the DCT technique. The value of correlation and SSIM is high in DWT technique as compared to DCT. In DWT technique we are getting better results in the distorted watermarked video. We can further enhancement on this topic by using different-different distortion models and we can increase the efficiency of the system.

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